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Original Article

DESIGN AND DEVELOPMENT OF SEMI-AUTOMATED CLIP BRACKET IN AUTOMOTIVE

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ABSTRACT

In PHA India private limited fuel tank door relief handle lever (hdl) assembly part has more quality issue, also customer complaint periodically due to clip is mounted by hammering with hand.

Due to above-stated condition, the part has the following problem in pha.india.private limited as well as from our customer end. (Hyundai.motor India ltd)

- ***Clip bracket improper seating with matching part.***
- ***Release mechanism not properly operated.***
- ***Clip bracket breaks often if more force applied.***
- ***Clip bracket comes out if less force applied.***
- ***UPH very less. (unit per hour)***
- ***Operator fatigue increased.***
- ***It leads to hand injury.***

KEYWORDS: Fuel Tank & EBB plating

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INTRODUCTION

To Research Work

In our company fuel filler bracket assy is assembled with 3 main components which include 2 metal components stamped from 200TON NC stamping press and a plastic component that comes from 110TON injection moulding [1-6]. After stamping it goes to plating namely EBB plating and the mould parts go to laser printing for customer identification after injection moulding [7-11]. The 3 parts assembled by the manual method in PHA assy shop and are moved to our customer end.

Figure 1: Fuel Filler Bracket Assembly

NEED OF THE RESEARCH WORK

The main aim of the research work is to analyse and improve the quality by changing the semi-automation line. The first reason why we chose this research work is that we were unable to meet our customer demand. So we decided on the process to improve capacity in the assembly line.

Frequently the answer is found with new technology solutions. Solution for the problem is to make feasible changes in the existing flushing process which is best performed already [12-15]. The daily demand from the customer is very difficult to meet with the existing flushing process. To satisfy customer, we are in the position of manufacturing parts at low cost and high productivity with better quality. Hence it becomes essential to reduce the cost and improve productivity to meet the customer demand [16-21]

FUNCTION OF THE PRODUCT

The main function of the fuel filler bracket is used to lifting the fuel tank cover in driver seat itself in cars such as **Santro, Accent, i10,** and **i20.**

It is fixed with nearby clutch and brake pedal and it is operated by driver's hand and for easy identification, the logo is printed on top of the lever[22-28].

When the lever is pulled up the fuel cover is opened through a linked mechanism. After filling the fuel the cover is closed manually.

Figure 2: Fuel Filler Handle Lever present Location in Car

PROBLEM DEFINITION

In our company's assembly line, the fuel filler bracket assembly is done by using the hammer. While in hammering the component sometimes damages as hammering depends on operator power and when this action is done repeatedly the force is fluctuated [29-31].

Due to this condition, the knob (moulding part) is possible to be broken.

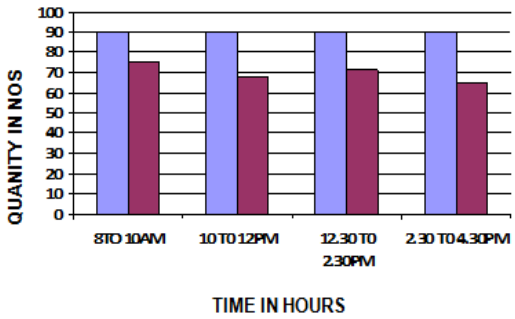

Figure 3: UPH Plan vs Actual

Our assembly line production unit per hours target is 90 nos. but in the present condition, we cannot meet our target as the operator's manual skills are considered to meet our target

INTRODUCTION THE PROCESS FLOW

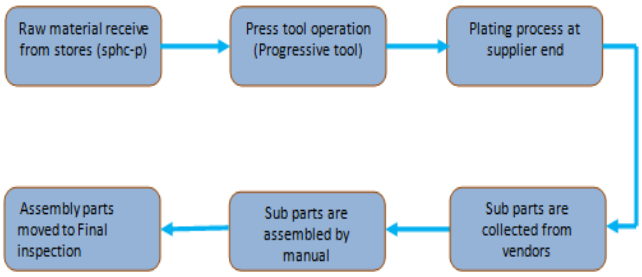

Figure 4: Process Flow of Fuel Handle Relief Lever Assembly

REJECTION ANALYSIS

In our company, the fuel filler bracket rejection is comparatively high due to various reasons. The torque uneven is a major problem that we are facing. The last year's rejection trend is shown below.

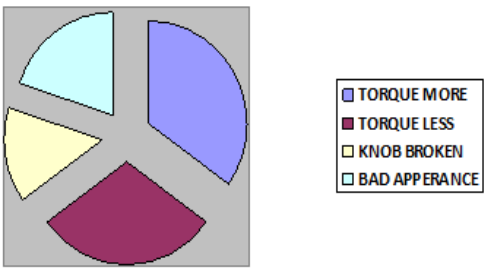

Figure 4: Rejection Analyses

IDEAS FOR PROCESS IMPROVEMENT

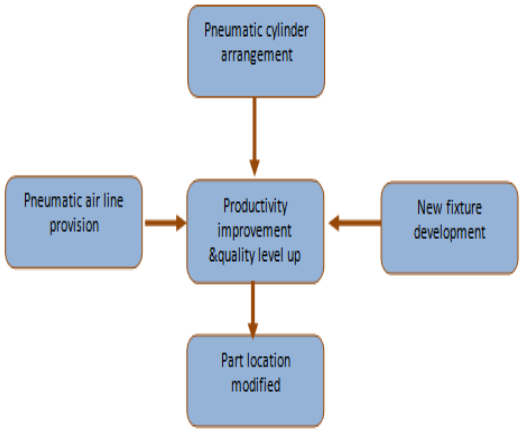

Figure 5: Analysis Chart to Improve the Process

From the above chart, we can make changes in the following data to improve and sustain the process.

PNEUMATIC CYLINDER ARRANGEMENT

Acceptable to change the design

PNEUMATIC AIRLINE PROVISION

Flushing is essential for the injector to maintain the cleanliness level.

NEW FIXTURE DEVELOPMENT

The flushing time reduced to be affected next stage process due to the failure of the next stage cleanliness. The Test plans run as per customer requirement.

PART LOCATION MODIFIED

Not possible to combine the process next machine. Another machine function not related to the flushing process.

AUTOMATION

Automation includes the use of various control systems to operate equipment such as machinery, plant processes, boilers and heat treatment furnaces, to modify telephone networks, to route and to balance ships.. Aircraft and other applications with minimal or reduced human intervention. Some operations are fully automated.

ASSEMBLY FIXTURE SELECTION

- Fixture design for ASSEMBLY process steps,
- 3D modelling with the help of NX-9 software.
- 2D Drawing with the help of Auto CAD software.
- Material selection.
- Design parameter & Calculation.
- Inspection.
- Result.

FIXTURE

The luminaire is a fixture used in the manufacturing industry. It is used to attach accessories (placement in a specific location or orientation) and to support the work [32-36]. Improving the efficiency of production by simplifying installation, reducing the need for skilled labour and increasing the compatibility of workers in production.

A device differs from the device in that the tool must move relative to the work piece when using a device; When the tool stops, a device moves apart. The luminaire must always be designed taking into account the economic efficiency; Since the purpose of these devices is to reduce costs, the cost reduction must be designed to overcome the cost of using the light. From an economic point of view, it is preferable to translate armour into a low-cost reduction for a continuous operation process, rather than a significant cost reduction for an occasional process.

Most accessories have a fixed component which is fixed to the floor or body of the machine, which is stationary with respect to the movement of the machining tool and has one or more movable components called clamps. These clamps (which can be used in various mechanical ways) ensure that the parts can be easily inserted into or removed from the machine and that they remain safe during operation. Many are also adjustable and allow the use of parts of different sizes for different operations. Luminaires should be designed so that the pressure or movement of the machining process (generally referred to as the power supply) is primarily directed to the fixed part of the luminaire. This reduces the risk of equipment failure, downtime and possible damage to infrastructure, components or operators.

FACTOR FOR FIXTURE SELECTION

Fixtures for flushing are designed in PRO-E & Auto cad software. Variety of fixture model created can be used for the flushing process. Finally, the capable fixture is designed. The flushing fixture clamping and decamping by using 23 pneumatic control. Because Pneumatic system is better than a hydraulic system. Also low-cost automation process.

Locating Bunk designed through-hole with ‘O' ring to avoid Oil Leakage. The butting injector designed inclined for easy loading purpose. Based on the existing Fixture design the HP pipeline fixed one by one per components. Now HP pipeline fixed through a manifold. The drawing of the existing is proposed.

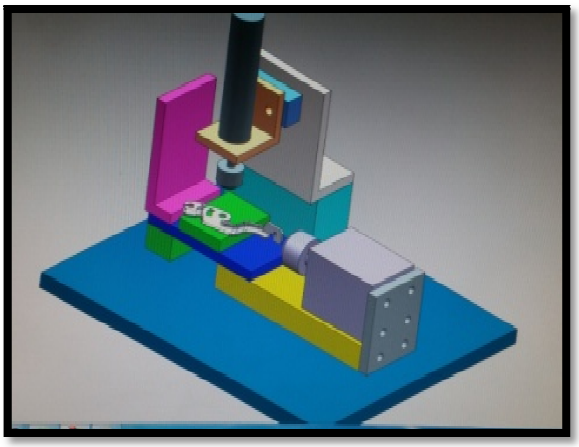

Figure 6: Fixture 3D View

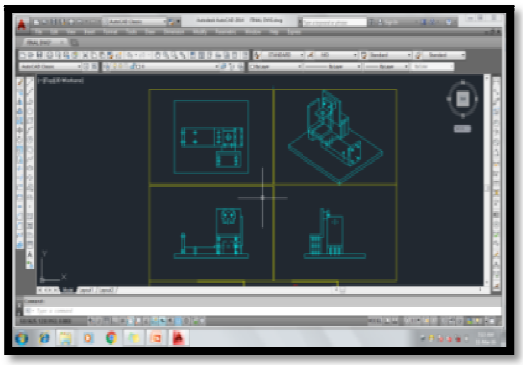

Figure 7: New Fixture 2d Assembly View

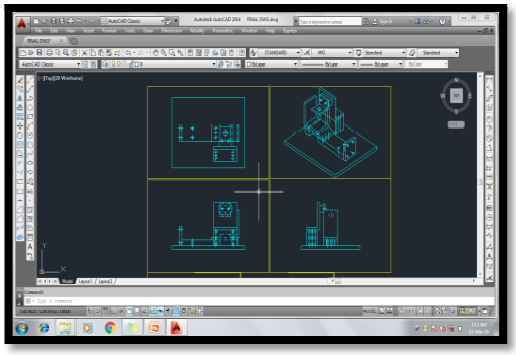

Figure 8: New Fixture 2D Front View

SELECTION OF CLAMPING CYLINDER

While selecting of clamping cylinder, first clamping mechanism types are pneumatic and hydraulic methods. The pneumatic system is good for this application. So we chose Pneumatic cylinder selection to be taken with calculation.

The diameter of the cylinder selection process:

Applying load in kg

Working Force Calculation

Force=Pressure × Area [Line pressure 5bar = 5N\mm2]

= 5 × d2. [Dia of the component=18mm]

= 5 × π/48*12²

=1271.7 N

Cylinder Diameter Calculation

FORCE

Pressure =AREA

Area =π/4*D²

1271.5

5 =π/4*D²

D2 = 323.23mm2

D = 17.99mm

FACTOR OF SAFETY

From the design data book the Factor of safety for cylinder diameter 10 to 20 = 3 to

4times. Hence the cylinder's diameter is 18mm for which Factor of safety is 3.2times

Diameter of the cylinder = 18×3.2

Diameter of the cylinder = 57.6mm

We consider the calculation and selecting the Pneumatic Cylinders in the diameter of 63mm.

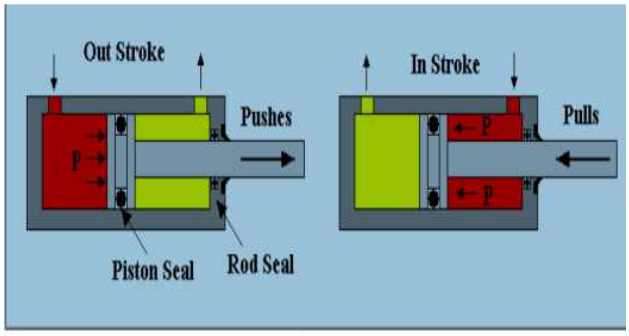

Figure 9: Cylinder Push and Pull Vie

XIV. PROCESS QUALIFICATION

The manufacturing system needs to be operated by the machine just like it is intended to run in production mode without affecting the process parameters. Exercises the equipment/manufacturing system again to find infant mortality uptime issues**.**

The following are things are considered while there is a change or modification process.

- Machine cycle time study,
- Process capability study,
- First-time quality trend,
- Process parameters updating.

For any process it is necessary to run production, minimum of 30nos continuous sample or 8hrs production for, to qualify for the procession. In our case, we take continuous 30nos sampling plan to qualify the process in the above-Mentioned considerations

MACHINE CYCLE TIME STUDY

The time required for a particular task to be repeated once is usually measured from "start," the start point of the process, from one product in the specified machine or process to the start of processing of another product. Similar to the same machine or the same process. The cycle time is generally classified info:

Manual Cycle Time

Load and unload parts while the part is in the same system/process. Add parts to the rotor.

Machine Cycle Time

The processing time of the whole machine.

Auto Cycle Time

The time a machine runs automatically without manual activity.

Overall Cycle Time

The time required for the production unit. This term is often used to refer to a single system or process.

Total Cycle Time

This includes all categories of machinery, processes and deadlines that must go through the product until it is the final product. This is not a delivery date, but it will help you make a decision. In most cases, the type of session duration is not important. The total duration of the session must be less than the connection time.

PROCESS CAPABILITY STUDY

The process capability of a process is the extent of variation in the Quality characteristic of the process output when the process is operating in a state of Statistical control under a given set of conditions.

It concerns with the ability of the process to produce output meeting specifications consistently. Takes into account variation caused by all the possible sources of variation.

Uses of Process capability study

- Provide Information to facilitate the design of product characteristics/tolerance.
- Assist process planners to select or modify a process
- Assist in establishing the interval between sampling for Process Control
- Specify the performance requirement of a new process
- Compare the capability of various processes
- Assigning work to machines
- Selecting between competing vendors
- Determining the economic nominal for an operation
- Reducing the variability in a process.

XV. TORQUE QUALITY TREND

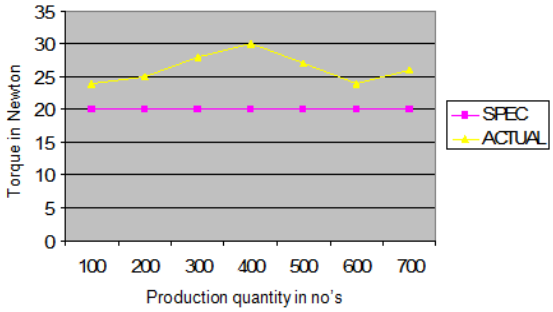

Figure 10: Torque Analysis

Torque is a very important factor so that the lever could not come out while operating the lever. After implementing the semi-automation with the help of pneumatic cylinder, torque was achieved and the problem was eliminated.

XVI. SUMMARY

From the components for assembly a Fuel filler assembly, the assembly line was selected to improve the productivity. As to meet the Quality improvement pneumatic cylinder were used in 2 shift working condition.

In addition to the excess investment by adding pneumatic cylinder, the total quality trend and UPH would go up. So we planned to set-up an improvement in that assembly process by eliminating manual assembly method.

Through this, we studied about the process and its behaviours. Upon the studies in the assembly technology semi-automation, we have to make up the possible changes in the fixture clamping design.

There we designed the fixture that is capable of loading 4 components at a time and modification in the clamping system. By this change, we had a possibility of modifying the process parameters for cycle time reduction.

By this modification, we will be able to achieve the tact time by reducing the cycle time up to 50%. This enables us to eliminate the excess manpower and possibility of running in three shifts a day.

Table 1: Comparison of Benefits

PHENOMENON	BEFORE	AFTER
Productivity	50 per hour	110 per hour
Rejection	8 no's per 100 (approx)	1 no per 100 (approx)
Safety	Possibility to hand injury	Safety enhanced
Morale	Operator fatigue	Fatigue elimination
Working shift	3 Shift	2 Shift

XVII. CONCLUSIONS

The following conclusion can be drawn based on the experimental study in "**Optimization of Semi Automation in Assembly line**".

- An elaborated study in the Selection of fixture and its characteristics.
- Designing the fixtures for assembly in an optimized way.
- Analysis in the cycle time.
- Cost analysis and process analysis are done.
- The cycle time and set-up time are reduced by 50%.

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